

Results from Carbon Dioxide Washout Testing Using a Suited Manikin Test Apparatus with a Space Suit Ventilation Test Loop

Cinda Chullen¹

NASA Johnson Space Center, Houston, Texas, 77058

Bruce Conger,² Bryan Kanne,³ Summer McMillin,⁴ Walt Vonau⁵
Jacobs, Houston, Texas, 77058

and

Mike Swickrath⁶

Battelle Memorial Institute, Columbus, Ohio, 43201

NASA is developing an advanced portable life support system (PLSS) to meet the needs of a new NASA advanced space suit. The PLSS is one of the most critical aspects of the space suit providing the necessary oxygen, ventilation, and thermal protection for an astronaut performing a spacewalk. The ventilation subsystem in the PLSS must provide sufficient carbon dioxide (CO₂) removal and ensure that the CO₂ is washed away from the oronasal region of the astronaut. CO₂ washout is a term used to describe the mechanism by which CO₂ levels are controlled within the helmet to limit the concentration of CO₂ inhaled by the astronaut. Accumulation of CO₂ in the helmet or throughout the ventilation loop could cause the suited astronaut to experience hypercapnia (excessive carbon dioxide in the blood). A suited manikin test apparatus (SMTA) integrated with a space suit ventilation test loop was designed, developed, and assembled at NASA in order to experimentally validate adequate CO₂ removal throughout the PLSS ventilation subsystem and to quantify CO₂ washout performance under various conditions. The test results from this integrated system will be used to validate analytical models and augment human testing. This paper presents the system integration of the PLSS ventilation test loop with the SMTA including the newly developed regenerative Rapid Cycle Amine component used for CO₂ removal and tidal breathing capability to emulate the human. The testing and analytical results of the integrated system are presented along with future work.

¹ Project Engineer, Space Suit and Crew Survival Systems Branch, Crew and Thermal Systems Division, 2101 NASA Parkway/EC5.

² Engineering Analysis Lead, Thermal and Environmental Analysis, 2224 Bay Area Blvd./JE-5EA.

³ Laboratory Technician, Space Environment Simulation, 2224 Bay Area Blvd.

⁴ Project Engineer, Hardware Systems Project Engineering, 2224 Bay Area Blvd./JE6WC.

⁵ Engineering Analyst, Thermal and Environmental Analysis, 2224 Bay Area Blvd./JE-5EA.

⁶ Principal Research Scientist, Energy Systems, 505 King Ave.